SEPTEMBER 16, 1991

CHEMICAL & ENGINEERING

NEWS

European Community

Chemical industry well prepared for 1992 market consolida

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CHEMICAL & ENGINEERING
NEWS
SEPTEMBER 16, 1991

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News of the Week

■ **Panel urges drastic changes in U.S. technology policy, while White House stalls formation of institute to promote critical technologies.** **Page 4**

■ **California chemists determine C_{76} fullerene to be an asymmetric molecule with a corkscrewlike twist to it.** **Page 5**

■ **European Community to consider tax on carbon-dioxide-generating fuels, a plan that would hit the chemical industry hard.** **Page 5**

■ **Edwin M. McMillan, Berkeley chemist who shared the 1951 Nobel Prize in chemistry, dies at age 84.** **Page 6**

■ **EPA issues the first federal standards for municipal solid-waste landfills, governing everything from design to cleanup.** **Page 6**

Business

In spite of falling price margins, ethylene production is up and headed for another record year, fueled by increasing exports and a building up of larger inventories. **Page 15**

Government

The chemist's role as expert witness in both civil and criminal cases, especially disputes over patents and those involving hazardous materials, is examined in chemical congress symposium; major reductions in nuclear weapons by the U.S. and the Soviet Union are urged in a recently released NAS report; EPA's new hazard ranking system is said to make it easier to get an accurate assessment at waste sites. **Page 19**

Science/Technology

More from the New York chemical congress: Enantiomeric intermediates for biologically, pharmacologically active products as well as enantiopure catalysts advance asymmetric synthesis; analytical chemistry reaps rewards of emerging spectroscopy; symposium underscores widespread concerns over future supply of chemists; phenols in fruits, vegetables, and green tea may reduce risk of cancer; new class of plant-derived proteins inhibits HIV in vitro; four Nobel Laureates share their thoughts on science and economics; and new fluorinating agents for enols developed. **Page 23**

Books

"Fusion: The Search for Endless Energy" by Robin Herman, takes on biases of its author, but is written in lively style. **Page 32**

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LETTERS

CHEMICAL SAFETY

Explanation for CO absorbant solution explosion

The delayed explosion in a sealed bottle of undefined total volume initially containing 53 g of cupric chloride dihydrate ($CuCl_2 \cdot 2H_2O$) in 300 mL of concentrated hydrochloric acid and 75 g of copper turnings reported by Ihsan U. Shah (C&EN, July 29, page 4) is most likely due to the evolution of hydrogen gas by the oxidation by protons of the excess copper metal (left after formation of CuCl). Using half-cell potentials available in James E. Huheey's "Inorganic Chemistry," 3rd Edition [Harper & Rowe, New York (1983)], one calculates the 25 °C equilibrium constant for the reaction $H^+_{(aq)} + Cl^-_{(aq)} + Cu_{(s)} \rightarrow CuCl_{(s)} + \frac{1}{2}H_{2(g)}$ to be 4.82×10^{-3}.

The large molality (16.0) of concentrated hydrochloric acid, and the large estimated mean ionic activity coefficient at that concentration, 42.4 ["International Critical Tables," Vol. VII, National Academy of Sciences (1962)] yields an estimated equilibrium partial pressure of hydrogen in this system of 2.22×10^3 atmospheres! This calculation assumes that ion pairing in the hydrochloric acid solution is negligible and that the ideal gas law applies—both dubious assumptions.

However, we believe that the calculated pressure, although probably considerably different from the true equilibrium pressure, does strongly suggest that an explosion would be the expected result, if a significant amount of copper metal is left to stand under a concentrated hydrochloric acid solution for a prolonged period of time in a sealed system of limited gas-phase volume. For Shah's application, the prudent way of proceeding would seem to be to avoid using excess copper metal in preparing the cuprous chloride solution.

Thomas G. Dunne
Reed College
Portland, Ore.

A personal tribute

I've started to write this letter many times, but have not, to now, been able to marshal my thoughts. This letter is meant to be a personal tribute to Marjorie Gardner, who was a friend and mentor to me. [Gardner died April 19 (C&EN, June 3, page 35).] She personified personal courage, professional dedication, and almost single-minded devotion to the improvement of science education—in particular, chemical education.

My mind is filled with vignettes of Marge: standing to deliver her address upon the occasion of her selection to receive the Division of Chemical Education's foremost award for science education; a dynamo of activity as chairman of the first International Conference on Chemical Education held in the U.S. at the University of Maryland; a vigorous proponent for an international perspective in science education; the private meetings in her room, during ACS or National Science Teachers Association meetings, as we shared experiences; her leadership of "leader-teachers" at the Lawrence Hall of Science; our first face-to-face meeting at the University of Maryland, where I observed a writing session for the Interdisciplinary Approaches to Chemistry modules; her ever ready willingness to advise me; her personal and ongoing encouragement of me as I began to assess different roles for my future; presiding at the Division of Chem-Ed meetings, committee meetings—and on and on.

I am ever grateful to this woman and thankful that I had the time to thank her personally before the one insurmountable barrier overtook her. I'll miss her at meetings, I'll miss our phone calls, I'll miss her indomitable and indefatigable spirit.

Ethel L. Schultz
Section Head, Division of Teacher Preparation & Enhancement
National Science Foundation
Washington, D.C.

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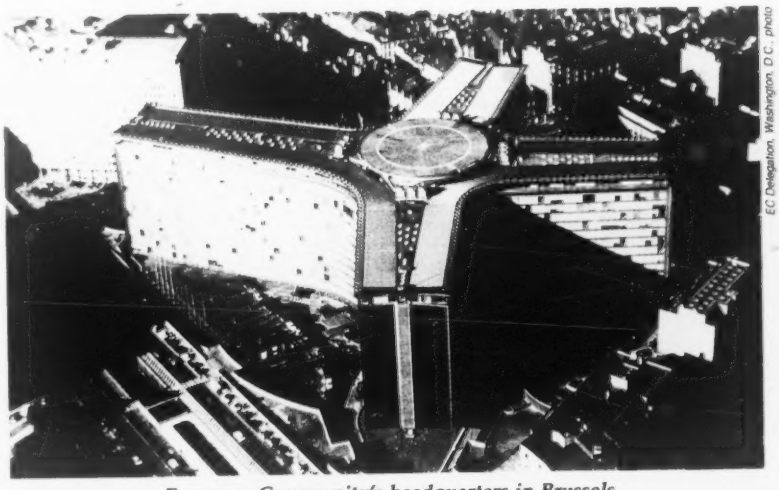
Chemical, Other Industries Ready For Push on Remaining EC-92 Issues

Most issues concerning Europe's pending single internal market have been dealt with, but the meaty topics of competition policy, energy, and the environment remain on chemical industry's plate

Patricia L. Layman, C&EN London



EC Delegation, Washington, D.C., photo

European Community's headquarters in Brussels

According to the sixth and most recent progress report on the European Community's move toward a single internal market, issued late in July by the EC Commission, of the 282 proposals gleaned from the original 301 in the 1985 White Paper on Completing the Internal Market, only 89 are left to be approved by the 12 member countries.

For the chemical industry though, much preliminary work has been accomplished. Most EC member nations have already adopted measures concerning customs formalities, technical harmonization and standards, pharmaceuticals and chemicals, commercial transport of goods, and intellectual property. But some sticky issues remain for the industry: competition policy, energy, and the environment.

Despite the large issues yet to be resolved, the member nations have waded through most of the white paper's proposals and, over all, seem to be weathering well the ups and downs implied by the proposed changes.

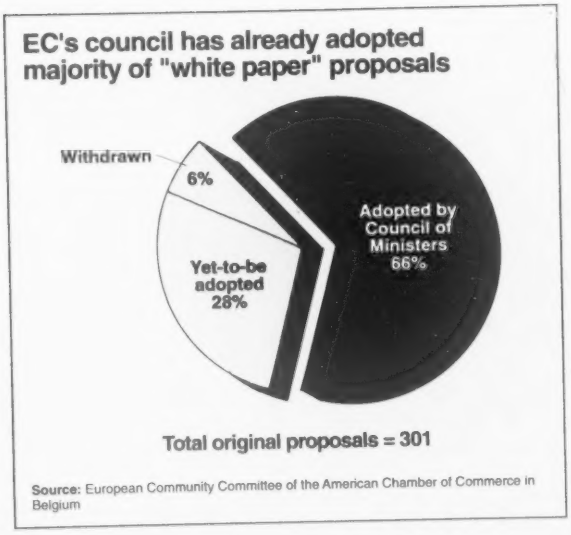
Six years can be a lifetime in politics. In fact, just three years ago, the topic at hand in the international political arena was "1992"—the year at the end of which the EC becomes a single, harmonized market. That was shortly after the EC passed the Single European Act, which would lead to the internal market.

Companies, analysts, and consultants both inside and outside EC countries were caught up in a frenzy of activity, examining the opportunities and problems posed by a single community of 12 member countries, with a population of 320 million and a combined gross national product of $4.6 trillion.

Since then, however, attention has wandered. A brief but serious war in the Persian Gulf; the end of the Cold War, with one of its main protagonists in the process of disintegrating; and the shucking of communism and a turn to free market economies by Eastern Europe have all diverted attention from peaceful harmonization in Western Europe.

Nonetheless, the end of 1992, and the single European market, continues to approach relentlessly. The population is still there, larger by 20 million since eastern Germany has joined the former West Germany. The gross national product—excluding eastern Germany—was more than $6 trillion in 1990. And legislation designed to help bring about the single European market, continues to be passed.

Moreover, another nearly 500 additional laws have been proposed to enable the EC to bring to fruition its single, common market. Some of these laws extend the


EC's council has already adopted majority of "white paper" proposals
Withdrawn
6%
Adopted by Council of Ministers
66%
Yet-to-be adopted
28%
Total original proposals = 301
Source: European Community Committee of the American Chamber of Commerce in Belgium

reach of topics touched on by the original 282. Others add areas that were not mentioned by the 1985 white paper, including the crucial subjects of energy and the environment.

However, European management is no longer obsessed with the issue. For example, a survey by the Management Consultants Association in London in 1989 showed top executives in major European companies were highly concerned about 1992, second on a list only to "people availability." A similar survey early this year showed 1992 as a subject had slipped to seventh place. People availability, on the other hand, remained a pressing concern.

The difference, this time, is that companies and other organizations have had a chance to become accustomed to the idea of one single community of 12 countries. They have come to grips with potential problems, and have begun planning how to exploit opportunities. They also have become—just slightly—bored by the whole subject.

Few EC observers would go so far as one cynical British securities analyst who observes, "Nineteen ninety-two is last year's flavor of the month, and now everyone has forgotten it. It has receded to take its proper place in the scheme of human existence, namely zero."

Officials at the European Chemical Industry Council (CEFIC) in Brussels say bluntly about 1992 and the work toward a single European market, "It's a dead issue. The spirit and purpose of 1992 has been achieved, so we aren't concerned about it. We took the decision, we wouldn't make 1992 an industry.

"We are looking now at some of the unresolved issues—the political objectives, and so on. There are still some important things, such as the harmonization of standards, taxes, and excise duties; telecoms; transport. CEFIC has a continuing role, but we are addressing them as individual issues, not as a major 1992 effort."

Even in Washington, the Chemical Manufacturers Association says it has been sidetracked by other issues, such as the General Agreement on Tariffs & Trade and North American free trade issues.

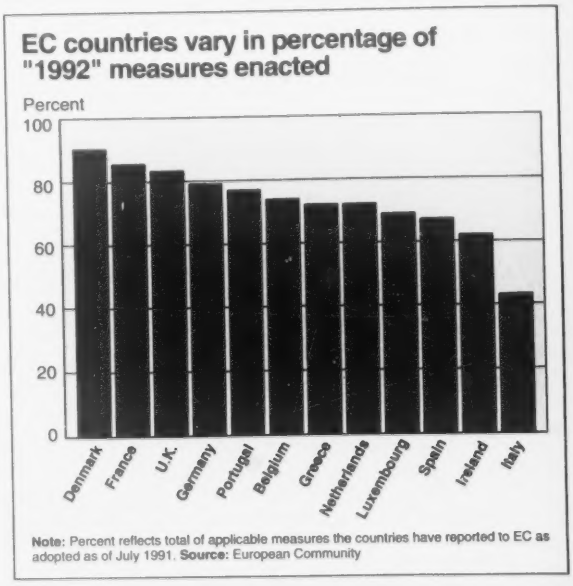
"Analysis of how to work with EC-1992 issues is being done more by individual companies—the decisions will be up to them," says one official at CMA. "The broad interpretations our members needed have been taken care of. Now the companies are determining their own strategies."

Many of that first batch of 282 proposals, which will have a particularly immediate impact on the chemical industry, have been implemented into national legislation by the member countries. The rate at which they and the second batch of proposals are being adopted, however, is rising.

According to the EC Commission's sixth report, the level of movement from community law into national law has risen from 69% in December 1990 to more than 73% in May 1991. In addition, the EC report says significant progress has been made in many areas. The more difficult problems lay in the general sphere. Actions taken in areas such as economics and finance, social laws, and mergers will have an impact upon all industries.

For example, the commission still has not received approval for a program to rationalize value-added, or sales, taxes. Value-added tax rates vary widely across the EC, with some countries having low rates for basic essentials and high rates for luxuries. At one point, Brussels hoped to set one rate throughout the 12 countries. However, the EC has decided that, just as different states in the U.S. can coexist economically as neighbors despite having different sales tax levels, so can EC countries have different value-added tax levels.

For U.S. companies, which early on worried that the subject of EC and 1992 was a smokescreen to conceal the rising barriers of "Fortress Europe," and that they would have no part of the lobbying and law-drafting



From concept to final vote, EC proposals move through intricate system

Spurred by a report in 1984 from the European Round Table (a Brussels-based group of European industrialists), Lord Cockfield, a British appointee to the Commission of the European Community, drafted in 1985 what became known as the White Paper from the Commission to the European Council on Completing the Internal Market.

The European Round Table report, urging pan-European movement toward a united home market, had dwelled solely on fiscal issues such as customs and harmonization of value-added sales taxes. Cockfield, who from 1985 to 1989 was the commissioner responsible for the internal market, customs union, taxation, and financial institutions, broadened the scope in setting out what was needed.

He pulled together all the outstanding issues his office was dealing with—about 300 measures—and divided them into four broad categories. And he picked an arbitrary target date—the end of 1992—to galvanize action, knowing that if there were no deadline, things would be put off and never get done at all.

The four broad categories were the freedom of movement of goods, people, capital, and services. Subsequent action by the EC added energy, health and safety, regional policy, research and technology, and trade policy—none of which had been on Cockfield's desk when he wrote his report in 1985, and hence were not included in the original paper.

The report was accepted by the EC's Council of Ministers, and the community eventually adopted it and the Single European Act, which became effective in 1987. The act enabled many measures to be passed by majority vote, rather than the unanimous vote that had been required up to that time. There was a complicated system set up for determining majority, but nonetheless it was a significant step forward for a group that was growing to the current total of 12 members.

Most of the original 300 measures, and nearly 500 additional ones added since 1988, are directives; only a few are regulations. Regulations have general application, are addressed to the governments of the member countries, and are immediately binding. Directives, on the other hand, set out results to be achieved by a deadline, but leave the "how" to each country, which must implement some form of national legislation in line with the directive's goals.

Draft proposals for legislation are drawn up by any one of the 23 specialized directorates general in the commission—rather akin to cabinet offices in an individual nation's government. After review by the commissioners, drafts are adopted as formal proposals and then submitted to the Council of Ministers. The council then consults the EC's European Parliament and the Economic & Social Committee, a free-standing "supercommittee" made up of employer, union, and general-interest representatives.

After negotiations and amendments in committees of both the Council of Ministers and the Parliament, a final proposal is written by the commission and sent to the council for a final vote.

Depending on the urgency of the matter, the enthusiasm of supporters, or the difficulty of balancing all interests, legislation can go from initial commission adoption to Council of Ministers' acceptance in a year—or it can take decades.

process, the EC Committee of the American Chamber of Commerce in Belgium has taken up the standard.

It now functions in parallel with the American Chamber of Commerce in Belgium, with a clearly defined role to play: namely, to represent the interests of European companies of U.S. parentage before the EC's legislative and administrative bodies. Its job is not only to comment on, but also, when appropriate, to propose policy and legislative initiatives to the EC.

The actions that any of the lobbying bodies take can only help companies throughout Europe, and given the importance of the chemical industry to the EC's member countries, the chemical industry will be a major beneficiary.

As Ian Butcher, commercial director of the consulting firm Kline S.A., in Brussels, points out, the EC chemical industry employs 2.1 million people, accounting for approximately 30% of world chemical production and sales, and is made up of 9000 chemical companies. By comparison, EC figures show that in 1989, the U.S. accounted for 23% of world chemical sales, and Japan, 17%.

Considering cutting barriers and reducing bureaucracy is a goal in the move to gain a single EC market, what will this mean for chemical producers?

Early on, Dow Europe conducted a preliminary investigation of the most important issues. Its estimate of operational cost savings: 1992 measures would save Dow Europe more than $50 million per year.

What Dow said at the time still holds: Truly global companies like ICI, IBM, and Dow, which already manage their businesses in Europe as interdependent parts of a global business, stand to benefit or to suffer far less from the impact of the single internal market than small or medium-size companies.

That's a point that Peter Gorle, managing director of London-based consultants Metra Martech, would agree with. "Nineteen ninety-two is about being big internationally, not about being big nationally," he says. The largest companies are already there, and small companies can always get by by nimbly serving niche markets.

The glitches, he adds, will come with the medium-size companies, many of whom still are not prepared for competing on a Europe-wide basis. Moreover, that will be true for both European and non-European companies.

There is a wide variety of barriers that the Single European Act sets out to eliminate—among them, physical barriers such as customs controls and border formalities, technical ones such as differing standards and quality norms, and fiscal ones such as value-added taxes and customs duties.

According to the EC's sixth report, the most progress has been accomplished in the area of customs formali-

ties. "Simplification of border controls and transportation are certainly important to the chemical industry, which is a major user—it may be the largest user—of cross-border road transport in Europe," says David Sears, manager of government relations in Europe for Exxon Chemical International in Brussels.

There may still be some problems, but there have been definite improvements. "The difference between what has been accomplished and the way it used to be is obvious when you get to the borders with Switzerland," adds his colleague Bruce Guy, logistics manager.

Well under way, too, is an overhaul of shipping regulations on international transport and "cabotage"—prohibiting a trucker from collecting a load to deliver on the return journey. Just as in the U.S. when interstate transportation was deregulated, return-trip loads promise substantial freight savings for shippers.

In the field of technical standards, the EC report says legislation for chemicals is in place. The commission is now focusing on ensuring that member countries properly apply the directives, and it is involved in updating legislation in line with safety and environmental concerns, the report notes. A major deadline involves putting into effect, through the member countries, the law on classification and labeling of dangerous preparations.

There are a variety of issues with this, notes Rachel Geatches, a specialist in the product and regulatory affairs group at the Chemical Industries Association in London. The EC's concerns run from directives on food additives, including colors and sweeteners, to compiling a priority list for dangerous substances, to hazard assessment. The latter would lead to a clean bill of health or enacting some degree of control, up to a ban.

Similarly, work is also going on to harmonize standards, such as for testing and packaging. With different national lobbying groups, the EC perhaps understandably leans toward international standards—those, for example, of the United Nations, or the International Standards Organization. More immediately, however, the EC has also decided that what is acceptable in one member country, must be acceptable in the others.

This has not always been an easy concept to sell across the EC, and has produced some singular challenges. For example, German brewers, proud of their centuries-old laws controlling beer content, fought hard—but unsuccessfully—to prevent beer being imported from other countries. Concern for purity? Protectionism? A bit of both? Whether consumer demand for the imports exists is beside the point; in this case, the EC has at least ensured consumer choice.

One marketing job for companies seeking to sell into the EC, then, is to judiciously select the first port of entry. Once accepted into that country, there will be acceptance throughout the European market. One international marketer, for example, contends that no importer with any sense at all would import goods into French ports—the French are simply too "notoriously prickly," even if that prickliness is skirting the line of permissibility under EC law. The solution? Import into Rotterdam or other more welcoming sites.

However, the most significant areas of legislative change for 1992 for the chemical industry—competition policy, energy, and the environment—are areas the latest EC report touches upon only briefly, if at all.

Competition policy, involving the thorny question of national aid to companies or industries, is particularly important in the chemical industry, which has a heavy representation of nationalized companies.

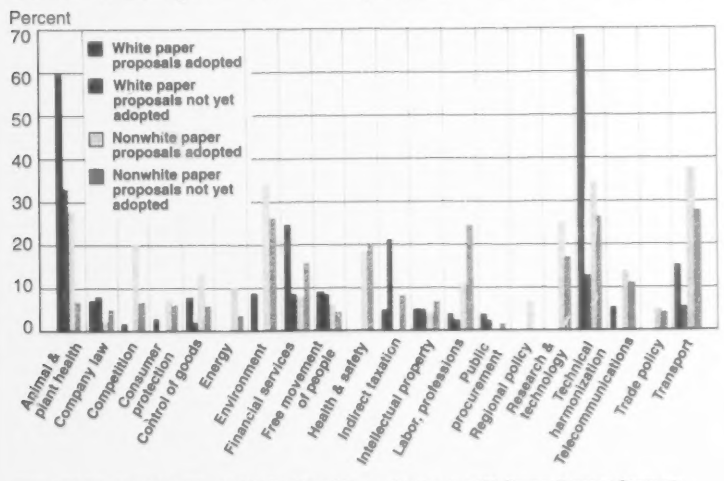
Notes Keith Wey, chief economist with the Chemical Industries Association, "Because of considerations given to regional problems and funding, some of the structural problems aren't being dealt with. For example, if a company is funded by the state, with terrific capital spending when by all commercial standards it should be shut down, that puts other companies at a disadvantage—or out of business."

Environmental legislation wasn't part of the 1985 white paper, but its importance has become inarguable. And it is one area that will have an impact on the chemical industry—and one of the most troublesome impacts.

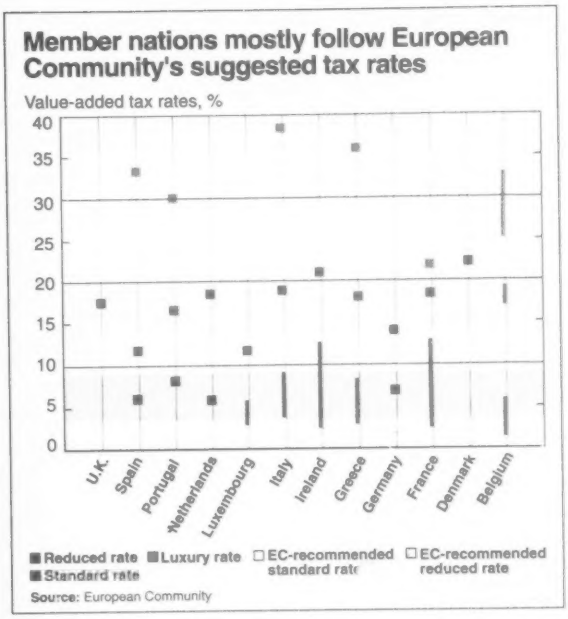
The topic of recycling, in particular, will trouble the chemical industry, predicts Metra Martech's Gorle. The EC's environmental activities for action, legislative input, and so on, cut across the board, through the activities of all the other groups within the commission.

However, there is a danger that unified, EC-wide environmental regulations are being preempted by national laws, a trend that alarms chemical companies. Not all the na-

Status of European Community's proposals for consolidation



Note: Total "white paper" proposals = 282. Total "nonwhite paper" proposals = 490. **Source:** European Community Committee of the American Chamber of Commerce in Belgium



tional efforts work. As Gorle notes, the Italian government planned a law banning nonrecyclable packaging, but such a law was not allowed by the EC.

On the other hand, the German government has taken a harder line, hard enough that the U.K. and French governments are complaining to the EC Commission. At least one chemical marketer, in fact, grumbles, "I'm not concerned about Fortress Europe—I am concerned about Fortress Germany."

The German initiative for recycling takes everything one step backward: If you sell or import a product, you have to take the packaging back, and—in order of preferability—reuse the packaging, recycle it, or dispose of it. It will be annoying enough for German companies or companies near their sales areas. But for companies hundreds or thousands of miles away, the prospect of dealing with unwanted packaging may prove an effective barrier to entry.

Among the benefits of EC-92, predicts Kline's Butcher, will be cheaper electrical energy prices, because of lowered costs from "common carrier" across-border sales.

However, the EC's other actions on energy threaten to override any benefits, believes Stephen Telegdy, Dow Europe's director of government affairs.

"The commission has correctly recognized that European energy markets need a closer look. For example, why should the natural gas price be coupled to the oil price? We support the EC initiative to liberalize the energy market," he says, but are unhappy with the slow progress being made.

One of the problems, as he sees it, is that member countries with a strong energy-supply industry, and a tradition of exempting government or private distributors from generally accepted rules of fair competition, strongly oppose the EC's efforts to liberalize European energy markets. And energy users, who might have protested the inaction, have traditionally been less well organized, and less vocal than energy lobbies.

That's a point that is not universally supported throughout the chemical industry. Chemical operations of oil companies, for example, would find it difficult to accept the same view. One marketer says, however, "We agree that there should be a thought-out policy. For example, electricity is the easiest to share, and it is not yet. The more you can share, the better."

European chemical producers firmly believe that—by and large—concerns about a Fortress Europe are groundless. That is not to say there won't be pressures. As another marketer notes, "Europe is full of companies that are protectionist." Pork-barrel politics are just as important in Europe as they are in the U.S.

Nevertheless, protectionism is not being written into the single European market by design. In fact, "EC standards will help overcome the oddities of national requirements, to keep restrictive measures at bay," points out Exxon's Sears. In a sense this is a return to the philosophy of the EC when it was founded, for totally nonrestrictive measures that would benefit anyone established and operating in the community.

What such factors as pan-EC standards and acceptance will not mean, however, is that non-European marketers will have a red carpet rolled out for them. Just as a U.S. East Coast producer would have to conduct market research in other areas of the U.S. before rolling out a product launch, so market research will become increasingly important for success in the EC.

A producer will have to become aware of packaging and product standards; of local or regional customer demands; of the relative advantages or disadvantages between building a grass-roots plant, or setting up a joint venture. But that kind of basic, slogging market research will be essential for any new marketer, even a European one.

Ultimately, the most serious pressures on EC will come on its own structure, as the number of member countries expands. The requirement for unanimity in voting by the Council of Ministers, one from each country, for example, for legislation on social and fiscal matters, will become more and more difficult as the community expands from its present 12 to as many as 24.

And expansion is coming, no question. The EC is currently processing applications for membership from Austria, Sweden, Cyprus, Malta, and Turkey. Finland and Norway are expected to apply next year. The commission is working on proposals that will put Hungary, Poland, and Czechoslovakia on the road to eventual membership. And many political analysts say those proposals will eventually extend to Romania, Bulgaria, and even Albania. The three Baltic states, now independent, likely will be part of the process as well.

No matter how many countries there are, however, Kline's Butcher says, "The EC really does want to open the market up—that is an official supranational position."

And, says the EC itself in its recent progress report, "Completion of the internal market for 1993 is an irreversible process, now entering the final straight." □

Ethylene Producers' Margins Drift Down As Output Climbs

Strong production growth for ethylene in first half spurred by rising exports and inventory building fails to boost profits as price cutting continues

Bruce F. Greek, C&EN Houston

Despite shrinking price margins, ethylene producers expect another record volume year in 1991. Unusually strong exports of ethylene derivatives—especially polymers and polymer intermediates—and the building of larger inventories likely will boost this year's output to close to 40 billion lb.

However, domestic consumption of ethylene derivatives is declining, mostly because of the recession. Prices for ethylene and its derivatives plunged in the first half of the year, drastically cutting returns on the huge investment in plants.

The rise in output and sales could bring the value of ethylene produced in the U.S. this year to more than $7.5 billion. That production value would not set a record, however, because last year's average selling price was about one third more than the projected selling price for 1991. In addition, annual output will increase much less than a third.

Price margins are expected to continue to fall for the remainder of 1991, but not at the rate seen earlier in the year, says Hugh S. Pylant, a senior consultant at Houston-based Pace Consultants. Production of ethylene also may drop later this year from levels of the first half of 1991. Forecasts of sizable declines in output over the past few months, however, have proved to be wrong.

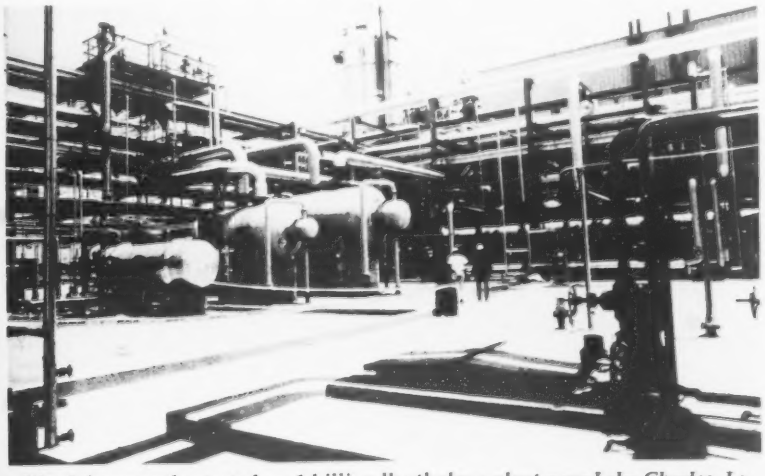
Unexpected events have complicated the forecasting for ethylene in 1991. Sizable capacity expansions are coming on stream later than scheduled. Export demand for ethylene polymers and other derivatives has grown more than forecast, and demand has remained high longer than was expected earlier this year, says John S. Doerr, who heads International PC, a Houston-based consulting firm specializing in ethylene markets.

Rising inventories of ethylene indicate that supply continues to be more than adequate. Problems at steam crackers have been numerous, but not serious enough to cause long outages.

Because of feedstock price variations, frequent changes of feedstocks are made in steam crackers that produce ethylene. Costs, therefore, have been volatile because crude oil prices are settling out higher than was anticipated at the end of the Persian Gulf War. Prices of light hydrocarbons—ethane and propane (widely used in steam crackers to make ethylene)—have fluctuated, influenced by small changes in inventories during the spring and summer, says Pylant.

Ethylene output in the first half of 1991 was about 19.6 billion lb, according to a survey of petrochemical production conducted by Ernst & Young for the National Petroleum Refiners Association (NPRA). The preliminary report on production of synthetic organic chemicals from the U.S. International Trade Commission estimates ethylene production was 19.5 billion lb in the first half of the year. Industry sources call this an unusually close agreement. This first-half output is up more than 10% over first-half 1990.

In the second quarter of 1991, production of ethylene declined slightly—about 3%—from production during the same quarter of 1990, according to the NPRA survey. The third-quarter production will be very close to the second quarter, according to some industry sources along the Gulf Coast. During July and August, plant problems caused minor losses in production. Planned shutdowns for maintenance work this month will largely be offset by



Westlake recently started up 1 billion lb ethylene plant near Lake Charles, La.

Ethylene use in exported polymers up 64% in first-half 1991

Millions of lb	First-half exports			Ethylene consumed in product exported in first half		
	1991	1990	% change	1991	1990	Change
Low-density polyethylene	678	399	70%	692	407	285
Linear low-density polyethylene	248	109	127	231	101	130
High-density polyethylene	461	330	40	470	337	133
Polystyrene	118	82	44	35	25	10
Polyvinyl chloride	774	469	65	372	225	147
TOTAL				1800	1095	705

Sources: Committee on Resin Statistics of the Society of the Plastics Industry, C&EN estimates

startup of new capacity or by startup of older capacity that has been idle for a few months.

Earlier in this quarter Westlake Petrochemical dedicated a 1 billion lb-per-year plant near Lake Charles, La., raising operable nameplate annual capacity for ethylene to about 44 billion lb at the end of the third quarter. For all of 1991, the average nameplate capacity is expected to total from about 1 billion to 2 billion lb less, owing to partial operation of Westlake's and Quantum Chemical's new plants. The Quantum plant began operation during the first quarter of the year.

Because of its startup during the middle of the first quarter of 1991, Quantum's plant, at Deer Park, Tex., likely will produce a maximum of 1 billion lb of ethylene this year. Westlake, with a mid-third-quarter startup, could put out as much as 400 million lb of ethylene this year, according to Michael Horvath Jr., a principal in Petrocon Associates, a consulting firm in Houston.

The only other large-capacity expansion for ethylene expected this year is Phillips 66's 1.5 billion lb capacity unit nearing completion at Sweeny, Tex. Although mechanical work is almost finished, the company says commercial operation will not begin until the fourth quarter. Because glitches often develop during startup of olefins plants, no significant ethylene output is expected from the Phillips expansion in 1991.

Various process improvements at other steam crackers will add to capacity, but in an unknown quantity. Because prices are declining and surplus capacity remains, there is little incentive for making improvements except during maintenance shutdowns. Consequently, the incremental capacity creep from process improvements during 1991 likely will be small, possibly about 500 million lb.

A huge part of the 1991 capacity expansions for ethylene will be used captively. For example, James Chao, president of Westlake, pointed out at his ethylene plant dedication that Westlake Polymers, another part of the Westlake Group, operates a 720 million lb-per-year polyethylene plant less than two miles away from the ethylene plant. The company has a 1 billion lb vinyl chloride plant at Calvert City, Ky., and also is building a styrene plant near the ethylene plant.

Quantum has plants that make all three types of polyethylene at several U.S. locations. The company also has other ethylene units. Despite the addition of 1.5 billion lb of ethylene capacity, Quantum will be able to make only 75% of its ethylene requirements, according to a spokesman.

Phillips also has large captive requirements for ethylene but they are not equal to its potential capacity. When the new unit at Sweeny comes on stream, Phillips will have about 4 billion lb of capacity at that location. After it rebuilds the polyethylene capacity destroyed in an explosion and fire almost two years ago, Phillips will still have captive use that is well below its capacity and will remain a major seller of ethylene.

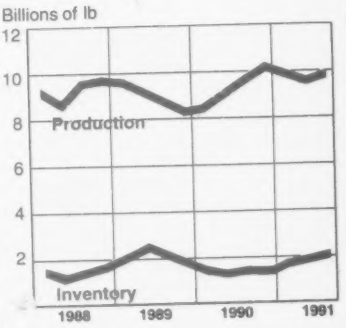
According to Gulf Coast sources, it is uncertain whether Phillips' new capacity and additional expansions in 1992 will be as fully utilized as its current operating capacity. Most of the increased output in 1991 has gone to exports or to inventory, points out John R. Hodson of Hodson & Associates in Houston. For most big-volume uses such as polymers, U.S. ethylene derivative consumption has slipped.

Exports of ethylene polymer derivatives are up more than 100% in a few instances, according to data compiled by the Committee on Resin Statistics of the Society of the Plastics Industry. For example, exports of linear low-density polyethylene were 248 million lb in the first six months of 1991, up 127% from first-half 1990. Exports of conventional low-density polyethylene increased 70% in the first half from a year earlier to 678 million lb.

Ethylene use also is increasing because imports of polymers have fallen. Imports of polyethylenes have dropped by sizable percentages in the first half of 1991, according to the SPI data. The imports, largely from Canada, offset U.S. production and use of ethylene. Imports of linear low-density polyethylene, largest in volume of the polyethylenes, fell to 316 million lb in the first half, down nearly 26% from the first half of 1990.

Other ethylene derivatives also have had large increases in export demand. For example, in the first six months of this year, exports of ethylene glycol increased 44% from the comparable 1990 period to 531 million lb, resulting in increased exports

Ethylene output, inventory follow similar pattern



Note: Production in fourth-quarter 1989 and first-quarter 1990 limited by freeze damage to plants, not demand reduction. Third-quarter 1991 is C&EN estimate. Source: National Petroleum Refiners Association

of the equivalent of 101 million lb of ethylene. Vinyl chloride exports more than doubled, to 1.02 billion lb. Increased vinyl chloride exports accounted for the equivalent of an additional 278 million lb of exported ethylene in the year's first six months.

Exports of ethylene derivatives in the first half took more than 1.2 billion lb of ethylene. This estimate includes ethylene used in polymers, ethylene glycol, vinyl chloride, and ethylene dichloride (the precursor of vinyl chloride). Additional small increases in ethylene exports could have come from other derivatives.

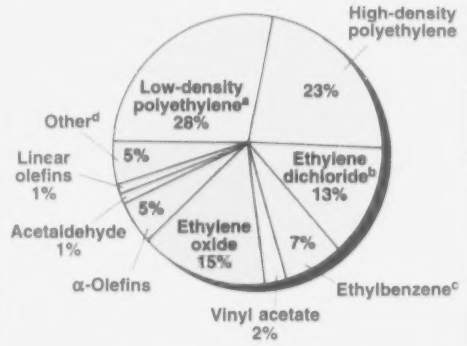
These increased exports of ethylene as derivatives easily account for much of the increase in ethylene production during the first half, points out Doerr. The remainder can be accounted for by lower imports of polyethylenes and by the additions to inventories.

NPRA data on inventories of ethylene show an increase of 195 million lb in the first quarter of 1991 and 109 million lb in the second quarter. At the end of second-quarter 1991, inventories were more than 1.8 billion lb, up 31% over those at the end of the second quarter of 1990.

How long the boom in exports of ethylene derivatives will continue could be a key factor in slowing down the decline in margins and holding up operating rates. The potential impact on U.S. exports by the recent startups of various ethylene and derivative plants in South Korea and other countries of the Far East is unclear, as is the future impact of similar plants now under construction.

Some sources suggest that demand growth for plastics and fibers based on ethylene in the Far East will require all of the output from the new and future plants in the region, as well as imports from the U.S. Others believe that derivative exports will hold up only as long as large quantities of consumer products containing ethylene derivatives are exported to the U.S. from the Far East. As the U.S. continues its slow recovery from the recession, demand for such imported goods can be expected to increase, and that could keep exports of ethylene derivatives strong.

Polymers, polymer intermediates dominate ethylene uses



Estimated 1991 consumption[e] = 37.8 billion lb

a Includes linear low-density forms. b Mostly for vinyl chloride. c Mostly for styrene. d Includes ethanol, ethylene-propylene rubber, ethyl chloride, aluminum alkyls, other intermediates, and miscellaneous uses. e Does not include inventory changes. **Source:** Pace Consultants

Perceived overcapacity ahead for ethylene, coupled with high output, will keep pressure on selling prices, sources say. Most contract ethylene prices—which less than a year ago were more than 30 cents per lb for a short time—settled at 19 cents per lb for July, off a cent from June. In July 1990, contract prices settled at 23 cents per lb.

Future prices are expected to decline because important segments of the merchant market are being turned into captive markets. However, the decline will have to slow should producers' costs exceed income. In July, total production costs—those for feedstocks, plant operation, depreciation, and overhead—reduced margins to the range of 3 to 8 cents per lb, depending on feedstock, says Pylant. If corporate overhead, feedstock delivery charges, and ethylene and coproduct delivery costs are included, some producers may have little net profit.

To take advantage of varying feedstock prices, many of the older steam crackers have been modified so that they can handle nearly all kinds of feedstocks, ranging from ethane to gas oils of different boiling ranges. Large quantities of coproducts—propylene, butadiene, and a pyrolysis gasoline stream containing various aromatics—are made if heavier hydrocarbons are used. The newer plants of Quantum and Westlake are designed to crack only the light hydrocarbons, because the owners have little or no use for such coproducts.

Selling prices of many of the coproducts have declined as much as or more than ethylene. The credits given to the cost of production of ethylene from the coproducts, therefore, do little to lower the cost. Costs of purifying and handling the coproducts reduce those credits even further. Consequently, the heavier hydrocarbon streams, such as gas oil, are now less economical for use in making ethylene.

Gas oils and similar streams continue to be used in steam crackers because they no longer have as much value in making gasoline components as they once did. A steam cracker will upgrade these hydrocarbons to more valuable products, but the profitability will be lower than if ethane were used under current economic conditions. If the total economics of making fuels and chemicals are integrated, for some companies operating steam crackers on feedstocks made up of high fractions of gas oils can be best.

These older steam crackers using heavy feedstocks in the current economic situation have significantly lower margins from making ethylene, sources say. Depreciation charges are lower because of the age of the equipment, but other costs are higher, including energy requirements due to lower efficiencies of old equipment. These units could be headed for the scrap pile.

If exports of ethylene derivatives fall and U.S. consumption doesn't rise enough to offset the export decline, then the additional pressure on prices for any length of time could cause some capacity shutdowns and some deferral of plans to expand capacity. This situation, reminiscent of the mid-1980s, would set the stage for another tight supply by the mid-1990s. □